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**PROTECTING LOCAL GROUND-WATER SUPPLIES
THROUGH WELLHEAD PROTECTION**

**OFFICE OF WATER
U.S. ENVIRONMENTAL PROTECTION AGENCY**

May 1991

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PROTECTING YOUR LOCAL GROUND-WATER SUPPLIES THROUGH WELLHEAD PROTECTION

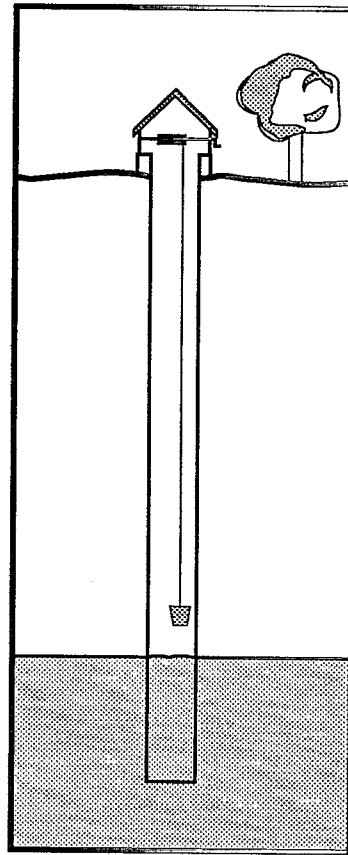
INTRODUCTION

If you are the mayor or water supply manager or other official of a small town, county, or parish, or an interested citizen, and if your community relies on ground water for its public water supply, this booklet can help you prevent that ground-water supply from becoming contaminated.

Protecting your ground-water supply before it becomes contaminated, instead of waiting until contamination occurs, is both smart and cost effective. Communities all over the country have learned that it can be very expensive to clean up ground water once contaminated. They learned the hard way that a little bit of prevention would have been worth many pounds of cure.

This guide outlines an easy to follow, five-step process that your community can take to protect your public water supply wells.

In addition, this guide presents an approach to protecting your ground-water supply that can be coordinated with existing state and federal ground-water supply protection programs such as EPA's Wellhead Protection, Underground Injection Control (UIC) and Public Water Supply System



programs. Check with your state environmental protection agency and your regional EPA office to determine what assistance and information is available to you.

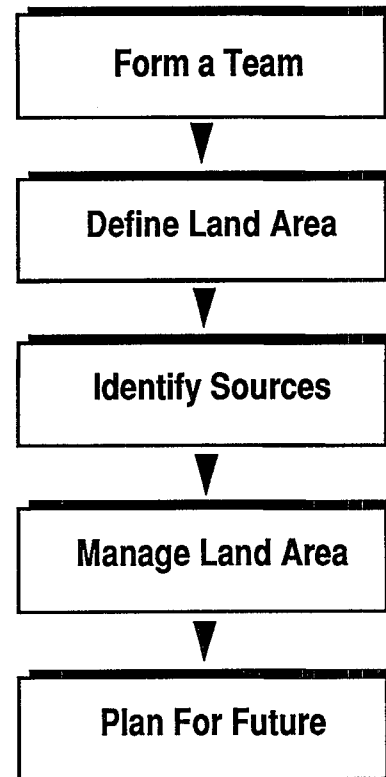
FIVE STEPS TO PROTECTING YOUR PUBLIC GROUND-WATER SUPPLY

Protecting your ground-water supply wells from contamination can be accomplished by completing five basic steps:

1. *Form a community planning team;*
2. *Define the land area to be protected;*
3. *Identify and locate potential contaminants;*
4. *Manage the protection area; and*
5. *Plan for the future.*

Step 1 *Form a Community Planning Team*

Although the size and membership of a community planning team may differ from one community to the next, it is important that the planning team represents all interests in your town. If there are existing groups in your community who have worked together



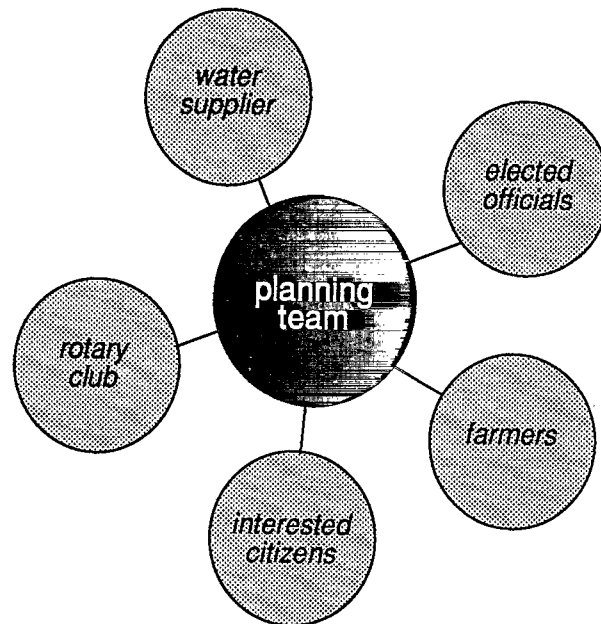
successfully in the past, it may be useful to build a planning team around them.

Consider including representatives from the following groups on your planning team: water suppliers; elected officials; local government agencies such as health, planning, and natural resources; businesses; land developers; community service organizations such as the League of Women Voters, Rotary Club, Lions Club; environmental groups; public interest groups; farmers; local fire department; and interested citizens.

Perhaps most important is the selection of a leader who can keep the planning team organized and on track. A local official or community leader who has already gained community support may be helpful in pushing management options through the proper channels.

Your team will also benefit tremendously from the advice of a hydrogeologist, engineer, and land planner who may teach others in the group or act as the group's technical advisor. The local extension service, soil conservation service, or state ground-water agency may be able to lend you support in this area.

Once you have formed the planning team, the next order of business will be to define a clear goal and objectives. The goal will remind the planning team what it is trying to do, while clearly defined objectives will give the team benchmarks for measuring progress.

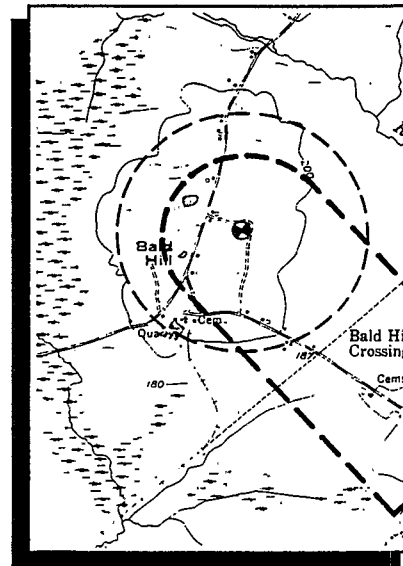


Step 2***Define the Land
Area to be Pro-
tected***

The first step for the planning team is to identify the land area that will need to be managed to protect your community's ground-water supply. The water pumped from a well passes through the surface and subsurface land surrounding the well and may extend up to thousands of feet from the well. This area is called a "wellhead protection area" (WHPA).

There are two good reasons for mapping wellhead protection areas. First, maps of WHPAs identify the ground-water area that is contributing directly to your well. Second, you can focus your management efforts on where they are most needed by identifying these areas of greatest concern.

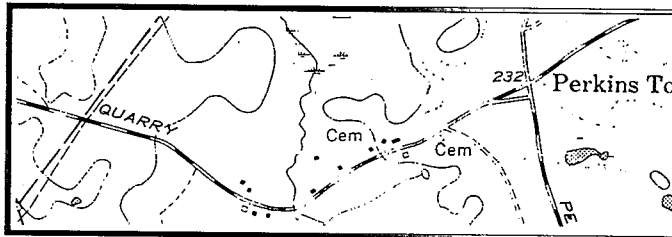
EPA has published guidance documents to help define wellhead protection areas. In addition, many states have developed wellhead protection programs and are recommending methods for mapping WHPAs. Information about the guidance documents or the status of your state's wellhead protection program is available from the Regional EPA Offices (see page 18 for the location of the appropriate Regional Office for your state). If your state has a wellhead protection program, you may be able to get assistance in mapping the protection area around your town's public



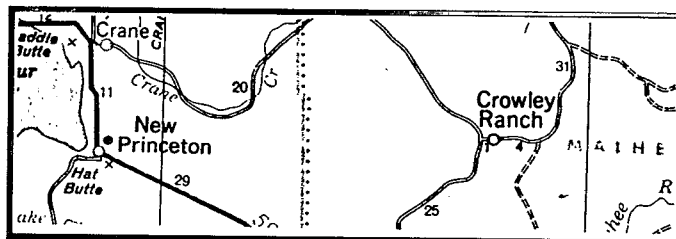
Finding a Base Map for Your Wellhead Protection Area

USGS topographic maps are easy to obtain and can be readily used as base maps for wellhead area protection programs. Other maps that can be used include county or city road maps, water resource maps produced by regional water authorities or the USGS, and USDA soil maps.

Topographic
Quadrangle
(USGS)



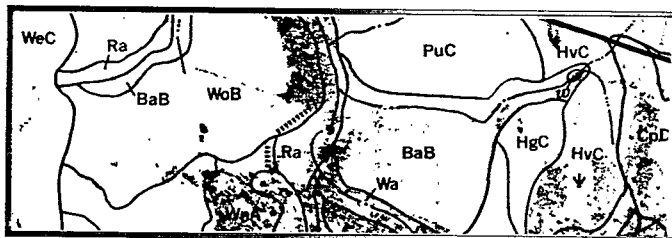
Local
Road Map



Hydrologic
Investigations
Atlas
(USGS)



Soil Survey Map
(USDA)



supply well(s).

There are several different methods of mapping WHPAs. They range from drawing a circle with a specified radius around the well to more detailed calculations and the use of computer models.

If your state does not have a wellhead protection program, an initial area having a radius of one-half to one mile around the public water supply well would be considered a good starting point. This initial wellhead protection area could then be refined at a later date.

When site specific information on well construction, soils, geology, and ground-water flow is available, detailed methods can be used to calculate accurate WHPAs. Ground water computer models, for example, can predict which land areas contribute water to the well under varying conditions. EPA has developed a simplified computer model that is available to help define WHPAs.

Your community also may be able to obtain the information and expertise necessary for mapping a wellhead protection area from other sources, including:

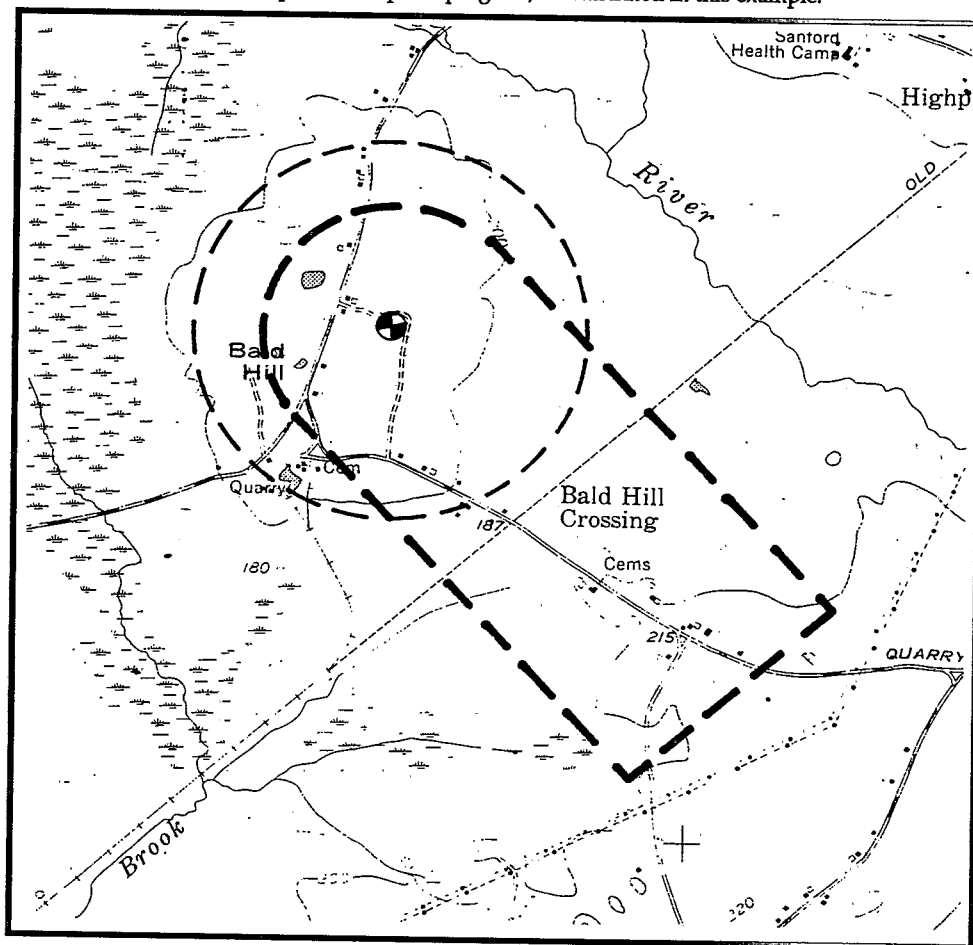
- Citizens of the community having professional expertise in these areas;
- Local universities or community colleges with

Mapping Wellhead Protection Areas




The Brookings County, South Dakota Planning Commission and Board of County Commissioners mapped wellhead protection areas identifying the ground-water area that directly contributes to the County's public supply wells. Once mapped, the County developed a protection program designed to manage land uses in the mapped WHPAs.

Mapping Your Wellhead Protection Area

Small communities can use a variety of techniques to map their wellhead protection areas, including EPA's simplified computer program, as illustrated in this example.



Legend:

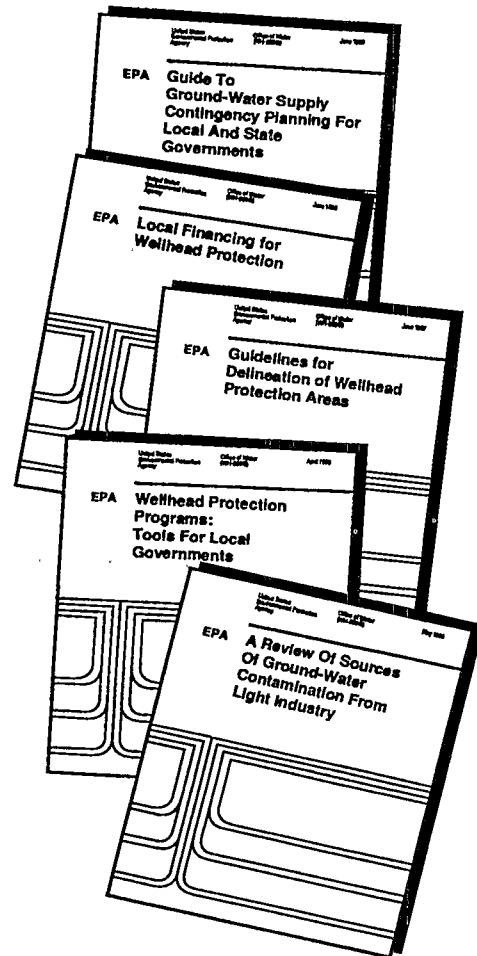
-  Public Water Supply Well
-  Wellhead Protection Area Using Fixed Radius
-  Wellhead Protection Area Using Simplified Computer Program



departments in geology, water resources, civil or environmental engineering, environmental planning, or agriculture;

- Consulting firms specializing in hydrogeology and land-use planning; and
- Federal, State, or county agencies such as the United States Geological Survey, Soil Conservation Service, County Extension Service, State Health or Environmental Departments.

Once the wellhead protection area has been identified, its boundaries should be drawn on a map so everyone in the community will be able to identify the area that needs to be protected. United States Geological Survey (USGS) topographic maps provide an inexpensive yet informative base map on which you can clearly show your WHPAs. They are available from sporting goods or outdoor recreational stores, book stores, or from the USGS. You also might use or draw relevant information from town parcel (tax assessor's plat) maps; natural resources maps; soils maps (available from the U.S. Department of Agriculture and Soil Conservation Service), or water resources maps from your local library or regional planning agency.

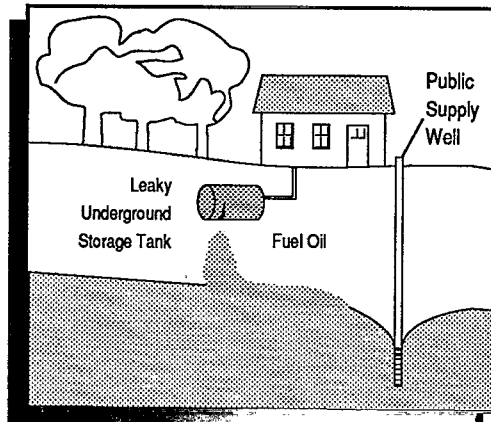


Step 3**Identify and Locate
Potential
Contaminants**

Once you know what areas in your community need to be protected, you can begin to identify and locate the potential threats to the quality of your ground-water supply. Any pollutants that are released within your WHPA have the potential to reach your well and contaminate the water. For example, less than one gallon of gasoline can contaminate one million gallons of ground water to the point that the well water is unusable for drinking purposes.

It can be helpful to divide your WHPA into smaller areas based on how the land is used (e.g. residential, commercial, agricultural, etc.) because different types of contaminants can be expected from different types of land uses. Table 1 shows some examples of potential contamination sources in different land-use categories.

Sources of information on existing land uses and potential contamination problems include the local phone book, the Chamber of Commerce's membership rosters, information maintained by your police and/or fire department and Federal, state, or county agency files. For example, the local agricultural extension agent may have records on chemical and manure storage and application areas in agricultural locations.



**TABLE 1. COMMON SOURCES OF GROUND-WATER
CONTAMINATION**

Category	Contaminant Source	
Agricultural	Animal burial areas Animal feedlots Fertilizer storage/use	Irrigation sites Manure spreading areas/pits Pesticide storage/use
Commercial	Airports Auto repair shops Boatyards Construction areas Car washes Cemeteries Dry cleaners Gas stations Golf courses	Jewelry/metal plating Laundromats Medical institutions Paint shops Photography establishments Railroad tracks and yards Research laboratories Scrap and junkyards Storage tanks
Industrial	Asphalt plants Chemical manufacture/ storage Electronics manufacture Electroplaters Foundries/metal fabricators Machine/metalworking shops Mining and mine drainage	Petroleum production/ storage Pipelines Septage lagoons and sludge Storage tanks Toxic and hazardous spills Wells (operating/abandoned) Wood preserving facilities
Residential	Fuel oil Furniture stripping/ refinishing Household hazardous products Household lawns	Septic systems, cesspools Sewer lines Swimming pools (chemicals)
Other	Hazardous waste landfills Municipal incinerators Municipal landfills Municipal sewer lines Open burning sites	Recycling/reduction facilities Road deicing operations Road maintenance depots Storm water drains/basins Transfer stations

Conducting a Search

After your team has completed an initial review of potential contamination sources, it is important to search for specific activities that present contamination risks. This does not have to be an expensive effort involving consultants. Local volunteers, particularly senior citizens, have proven very effective in identifying potential contamination risks. Groups such as boy or girl scouts, 4-H, and volunteer fire departments also generally are willing to participate in local public service projects.

Perhaps the easiest way to conduct the field search is to make copies of your wellhead protection area map, divide the protection area into sections, and have volunteers mark on the map the contaminant sources they find within their sections.

The information collected should include a description of the activity, its location, the volume of material stored and handled, and any permit references. The final product should be a master wellhead protection area map. This map will identify all of the contaminant sources of concern within the protection area and present some indication of the nature and potential threat posed by those sources.

Once the existing sources have been identified and assessed, the next step is to determine if any threats could be sited within the wellhead protection area in the future. A close look at the current zoning map or master plan

Conducting the Search for Possible Contaminants

The Texas Water Commission (TWC) organized a volunteer group of senior citizens to help conduct inventories of possible contaminant sources in El Paso, Texas. Using checklists, maps, and materials supplied by the TWC, the volunteers identified and collected information on numerous potential ground-water contamination sources.

Using a similar approach, Cuba, Missouri residents successfully conducted a door-to-door survey and located 465 possible sources of ground-water contamination.

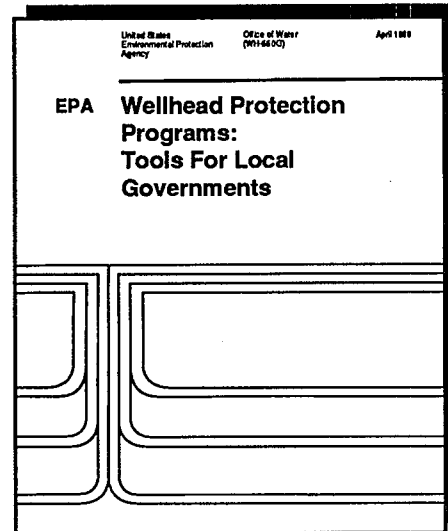
prepared by your community or your county may reveal that industrial or commercial activities could be developed within the WHPA. If your community has not adopted a zoning ordinance, this might be the time to consider doing so to protect your water supply.

Step 4 *Manage the Protection Area*

The management of activities (subdividing land, building roads, constructing and using buildings) within the WHPA usually is the responsibility of your local government. This responsibility can be an opportunity — a chance to preserve a resource critical to future growth and development. There are many ways to manage your WHPAs; some may be more appropriate for your community than others. These WHPA management methods or tools can be divided into two broad categories: regulatory and non-regulatory controls.

Regulatory Controls

Small cities and towns have relied on zoning to guide their growth and protect water resources since the early 1900's. Zoning approaches can be used to separate different activities within the community and keep conflicting land uses from being sited next to each other. For example, a zoning regulation can be adopted to prevent new underground storage

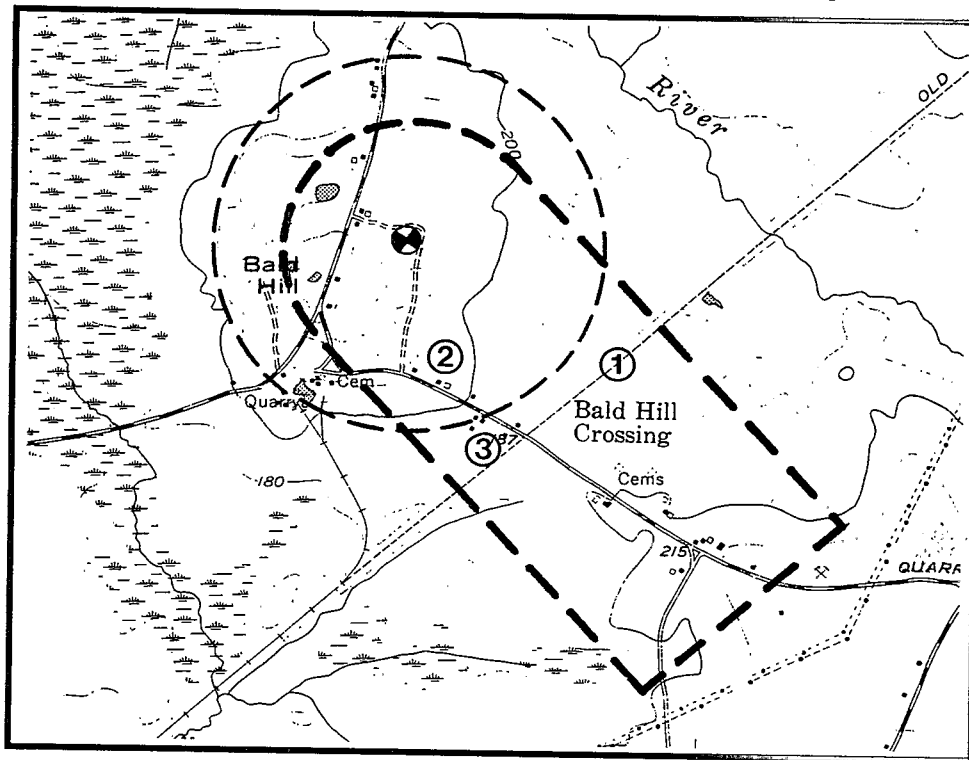


Zoning




Clark County, Virginia adopted a zoning overlay district to prevent development incompatible with ground-water protection. Activities that are prohibited in the district include mining, land fills, underground storage tanks, and land application of sewage sludge. A minimum of two acres of land is required for the construction of residential dwellings.

Identifying and Managing Contaminant Sources of Concern

Once the wellhead protection areas are mapped, community planners can locate the contaminant sources of concern on the map. As a general rule, planners need to locate only sources within the WHPA. Having identified the important contaminant sources, the planning team can then use a variety of approaches to manage these sources, as illustrated in this example.



Legend:

-  Public Water Supply Well
 Wellhead Protection Area
- ① RAILROAD;** Possible Contaminant Sources Include:
 Herbicides and accidental hazardous substance spills.
 Management Options Include:
 a. Railroad company agrees to reduce herbicide use.
 b. Slow train speeds to prevent derailment within WHPA.
- ② BALD HILL FARM;** Possible Contaminant Sources Include:
 Pesticide, nitrogen runoff from feedlots
 Management Options Include:
 a. Reduce use of pesticides within WHPA
 b. Adoption of regulations governing feedlots and manure disposal
- ③ BALD HILL SERVICE STATION;** Possible Contaminant Sources Include:
 Leaking underground fuel tanks, oil and fuel spills
 Management Options Include:
 a. Groundwater monitoring to detect leaks and spills
 b. Removal of old underground storage tanks
- 1000 0 2000 3000

 scale (feet)

tanks of petroleum from being installed within wellhead protection areas. In addition, zoning regulations could include the adoption of new districts to link the mapping of WHPAs with future management strategies.

Subdivision control rules and regulations also can be used to protect ground-water quality. When parcels of land are divided, subdivision regulations can be used to ensure that drainage from new roads is either treated or directed away from WHPAs.

Health regulations can be very effective in protecting ground-water quality. These controls are usually contaminant-source specific (e.g., for septic systems, underground storage tanks, toxic and hazardous materials control).

Regional approaches are options to consider when your local government does not have the power to regulate a certain activity or when a multi-community approach is necessary. It may be that the WHPA for your community's well extends into another town or state. Because the management techniques described above are difficult or impossible to apply outside your town, you may need to approach the neighboring community or your state legislature to create a special district for the joint management of the resource. Through a special ground-water protection district, you can establish consistent local controls across the entire WHPA and avoid piecemeal protection efforts.

Health Regulations

Provincetown, Massachusetts' 1.2 million gallon-per-day wellfield was closed due to adjacent ground-water contamination from an underground petroleum storage tank. After over \$6 million in state and local funds were used to study, design, and install a treatment system, the town developed an underground storage tank health regulation to prevent similar occurrences from happening in the future.

Regional Approach

When ground-water contamination problems became evident in the Hunt River Aquifer located in eastern Rhode Island, officials from the three communities sharing the aquifer joined forces to ensure that ground water be protected from further contamination. The combined efforts ensure consistent protection of the resource, including ground-water monitoring, controls over septic systems, and proper handling, storage, and disposal of toxic hazardous waste.

Non-Regulatory Controls

Non-regulatory controls are those that do not involve the regulation of an individual's property and, when combined with an appropriate regulatory program, allow for the strongest possible management of your ground-water resource. Some non-regulatory approaches to consider include:

- Conduct education programs and workshops to inform your fellow city and town residents about the importance of protecting the community's ground water;
- Prepare brochures or pamphlets on the importance of disposing of pesticides, used oil, and other contaminants properly;
- Monitor your community's water quality, especially between existing water quality threats and your public wells;
- Acquire land within your WHPAs, either by purchase or by techniques such as easements, conservation restrictions, or "bargain sales".

Finally, regardless of what management steps are taken, remember to stay focused on the goal: the protection of your community's drinking water supply.

Public Education Programs

Accomack and Northampton Counties, Virginia have developed comprehensive public education programs on ground-water protection for county residents. These programs range from distribution of brochures regarding ground-water protection to establishing forums on the role of county residents in protecting WHPAs from contamination.

Ground-Water Monitoring

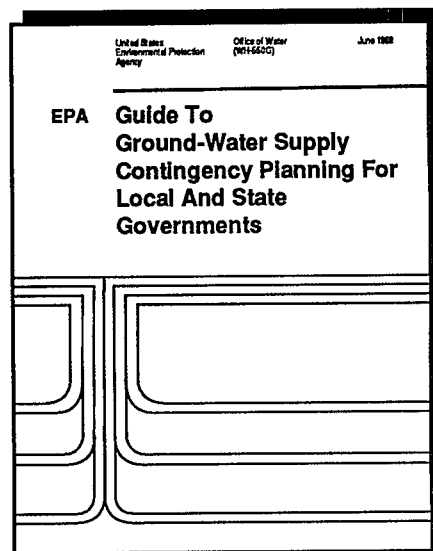
After a neighboring community lost half of its public water supply due to industrial contamination of the ground water, Littleton, Massachusetts' Water Department developed a ground-water protection strategy that included the placement of monitoring wells in strategic locations around industries and other potential pollution sources in town. The passage of a hazardous materials bylaw requires industries to install ground-water monitoring wells and pay for the inspection and sampling conducted by the town.

Step 5 *Plan for the Future*

Perhaps the most important step to take in protecting your town's ground-water supply is to sustain your protection efforts into the future. One year of intense ground-water protection measures is not likely to be adequate to establish long-term ground-water protection. Even modest ground-water protection efforts will be more effective if they are sustained.

The planning team should review the protection program each year to see where your community can improve its efforts. The planning team should think about future water supply needs and the type of program it would like to have in place five or ten years from now. It's important to try and identify potential future problems and figure out ways to head them off before they occur.

Even the most comprehensive wellhead protection program may fail to protect your community's wells. For this reason, it's important for your community to be prepared in case its water supply becomes contaminated. The planning team should begin to develop a contingency plan for response procedures and alternative water supplies in case the water supply is disrupted by contamination or other events.



Contingency Plans

Sioux Falls, South Dakota is served by a single well field that is located adjacent to industrial businesses, including the municipal airport and a petroleum storage facility. Several spills and tank leaks have occurred in the past prompting the city to develop emergency response procedures and a contingency plan to react to spills and leaks.

OVERCOMING OBSTACLES

The greatest obstacle that most small communities face in trying to implement a wellhead protection program is insufficient funds. Using a little creativity, it is possible to stretch the resources you do have and make a protection program work in your community. Using volunteers whenever possible can help control overall program costs. Local schools and universities may provide help as well. It also may be worthwhile to cosponsor a program with another organization interested in maintaining a clean water supply (e.g., local water supplier, environmental interest group, League of Women Voters, local industry, and farmers) and willing to share the cost of the program.

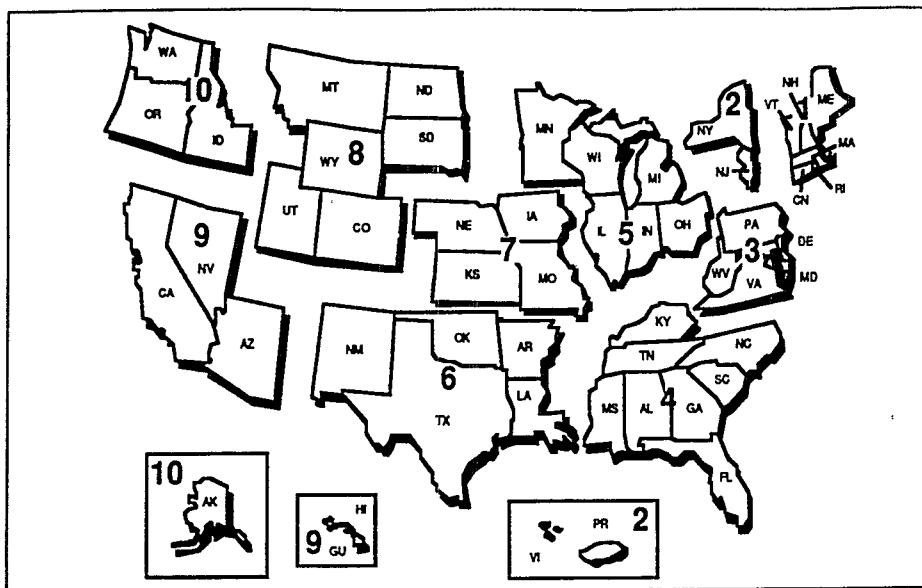
Financing Wellhead Protection

The Town of Bourne, Massachusetts and Collier County, Florida have generated funds through taxation for the purposes of ground-water protection. Another approach is the creation of a special "land bank" that is financed from real estate transactions. Nantucket, Massachusetts has used funds generated by a land bank to purchase lands within wellhead protection areas.

PULLING TOGETHER YOUR PROGRAM

Now that you have had a chance to review the five-step approach to ground-water protection, it is time to evaluate how this process can work for you. The approach provided here, along with other information available from EPA and your county and state offices, is meant to serve as a general guide to developing a ground-water protection program that will best serve the unique needs of your community. Talk with the people in your town. Find out who is interested in wellhead protection and get them involved. Contact local, state, and EPA officials for assistance; they would rather help you protect what you have now, than try to help you clean it up or replace it later.

EPA Regional Ground-Water Offices



Ground Water Management Section
Water Management Division
U.S. EPA, Region I
JFK Federal Building, WGP
Boston, MA 02203
(617) 565-3810

Office of Ground Water
Water Management Division
U.S. EPA, Region II
290 Broadway, 24th Floor
New York, NY 10007-1868
(212) 837-3875

Ground Water Protection Section
Water Management Division
U.S. EPA, Region III
841 Chestnut Street
Philadelphia, PA 19107
(215) 597-2786

Ground Water Protection Branch
Water Management Division
U.S. EPA, Region IV
345 Courtland Street, NE
Atlanta, GA 30385
(404) 347-3888

Ground Water Protection Branch
Water Management Division
U.S. EPA, Region V
77 West Jackson Boulevard
Chicago, IL 60604
(312) 888-1490

Office of Ground Water
Water Management Division
U.S. EPA, Region VI
1445 Ross Avenue
Dallas, TX 75202-2733
(214) 885-8448

Office of Ground Water
Water Management Division
U.S. EPA, Region VII
726 Minnesota Avenue
Kansas City, KS 66101
(813) 551-7033

Ground Water Branch, 8WM-GW
Water Management Division
U.S. EPA, Region VIII
999 18th Street, Suite 500
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Ground Water Protection Section
Water Management Division
U.S. EPA, Region IX
75 Hawthorne Street
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